PRESS RELEASE
Date Released: Friday, September 12, 2003
Massachusetts Institute of Technology

MIT-led Team: Dark Gamma-ray Bursts More Flighty Than Shy

SANTA FE, NM--Astronomers led by an MIT team have solved the mystery of why nearly two-thirds of all gamma-ray bursts, the most powerful explosions in the Universe, seem to leave no trace or afterglow: In some cases, they just weren't looking fast enough.

New analysis from the speedy High Energy Transient Explorer (HETE), which locates bursts and directs other satellites and telescopes to the explosion within minutes (and sometimes seconds), reveals that most gamma-ray bursts likely have some afterglow after all.

Scientists will announce these results today at a press conference at the 2003 Gamma Ray Burst Conference in Santa Fe, N.M., a culmination of a year's worth of HETE data.

"For years, we thought of dark gamma-ray bursts as being more unsociable than the Cheshire Cat, not having the courtesy to leave a visible smile behind when they faded away," said HETE Principal Investigator George Ricker, a senior research scientist at the Massachusetts Institute of Technology's Center for Space Research.

"Now we are finally seeing that smile. Bit by bit, burst by burst, the gamma-ray mystery is unfolding. This new HETE result implies that we now have a way to study most gamma-ray bursts, not just a meager one third."

Gamma-ray bursts, likely announcing the birth of a black hole, last only for a few milliseconds to upwards of a minute and then fade forever. Scientists say that many bursts seem to emanate from the implosion of massive stars, over 30 times the mass of the Sun. They are random and can occur in any part of the sky at a rate of about one per day. The afterglow, lingering in lower-energy X-ray and optical light for hours or days, offers the primary means to study the explosion.

The lack of an afterglow in a whopping two thirds of all bursts had prompted scientists to speculate that the particular gamma-ray burst might be too far away (so the optical light is "redshifted" to wavelengths not detectable with optical telescopes) or the burst occurred in dusty star-forming regions (where the dust hides the afterglow).

More reasonably, Ricker said, most of the dark bursts are actually forming afterglows, but the afterglows may initially fade very quickly. An afterglow is produced when debris from the initial explosion rams into existing gas in the interstellar regions, creating shock waves and heating the gas until it shines. If the afterglow initially fades too quickly because the shock waves are too weak, or the gas is too tenuous, the optical signal may drop precipitously below the level at which astronomers can pick it up and track it. Later, the afterglow may slow down its rate of decline--but too late for optical astronomers to recover the signal.

HETE, an international mission assembled at and operated by MIT for NASA, determines a quick and accurate location for about two bursts per month. Over the past year, HETE's tiny but powerful Soft X-ray Camera (SXC), one of three main instruments, accurately determined positions for 15 gamma-ray bursts. Surprisingly, only one out of the SXC's fifteen bursts has proven to be dark, whereas ten would have been expected based on results from previous satellite.

An MIT-led team has concluded that the reason that afterglows are finally being found are twofold: The accurate, prompt SXC burst locations are being searched quickly and more thoroughly by optical astronomers; and the SXC bursts are somewhat brighter in X rays than the more run-of-the-mill gamma-ray bursts studied by most previous satellites, and thus the associated optical light is also brighter.

Thus, HETE seems to have accounted for all but about 15 percent of gamma-ray bursts, greatly reducing the severity of the "missing afterglow" problem. Studies planned by teams of optical astronomers over the next year should further reduce, and possibly even eliminate, the remaining discrepancy.

Gamma-ray hunters are challenged. Because of the nature of gamma-rays and X-rays, which cannot be focused like optical light, HETE locates bursts within only a few arcminutes by measuring the shadows cast by incident X-rays passing through an accurately calibrated mask within the SXC. (An arcminute is about the size of an eye of a needle held at arm's length.) Most gamma-ray bursts are exceedingly far, so myriad stars and galaxies fill that tiny circle. Without prompt localization of a bright and fading afterglow, scientists have great difficulty locating the gamma-ray burst counterpart days or weeks later. HETE must continue to localize gamma-ray bursts to settle the discrepancy of the remaining dark bursts.

The HETE spacecraft, on an extended mission into 2004, is part of NASA's Explorer Program. HETE is a collaboration among MIT; NASA; Los Alamos National Laboratory, New Mexico; France's Centre National d'Etudes Spatiales (CNES), Centre d'Etude Spatiale des Rayonnements (CESR), and Ecole Nationale Superieure del'Aeronautique et de l'Espace (Sup'Aero); and Japan's Institute of Physical and Chemical Research (RIKEN). The science team includes members from the University of California (Berkeley and Santa Cruz) and the University of Chicago, as well as from Brazil, India and Italy.

At MIT, the HETE team includes Ricker, Geoffrey Crew, John Doty, Roland Vanderspek, Joel Villasenor, Nat Butler, Allyn Dullighan, Gregory Prigozhin, Steve Kissel, Alan Levine, Francois Martel, and Fred Miller; at Los Alamos National Laboratory, team members are Edward E. Fenimore and Mark Galassi; at the University of California at Berkeley, Kevin Hurley and J. Garrett Jernigan; at the University of California at Santa Cruz, Stanford E. Woosley; at the University of Chicago, Don Lamb, Carlo Graziani, and Tim Donaghy; and at NASA's Goddard Space Flight Center, Thomas L. Cline. In Japan, HETE scientists include Masaru Matsuoka at NASDA, Nobuyuki Kawai at Tokyo Institute of Technology, and Atsumasa Yoshida at Aoyama Gakuen University; in France, Jean-Luc Atteia at Observatoire Midi-Pyrenees, and Michel Boer and Gilbert Vedrenne at CESR.

For more information, refer to http://space.mit.edu/HETE/.